TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Room 617 Wachman Hall

Wednesday, 1 December 2010, 4:00 p.m.
(tea at 3:45)

Data mining and Shannon sampling on combinatorial graphs

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Abstract. A very common assumption is that a large data set is a sampling of a smooth low-dimensional Riemannian manifold M embedded into a high-dimensional Euclidean space. One can convert such data set into a weighted graph G that "represents" M. The corresponding discrete Laplace operator $\mathcal{L}$ can be considered as an approximation to the Laplace-Beltrami operator of the Riemannian metric on M. By using a discrete Laplace operator $\mathcal{L}$ on G one can introduce subspaces of bandlimited functions on G.

The goal of this talk is to show that analysis of lower frequencies on a graph (finite or infinite) can be performed on a smaller subgraph. The main result gives sufficient conditions on a subset of vertices to be a sampling set for a subspace of bandlimited functions on graphs. Note that in many situations lower frequencies are more informative while higher frequencies are usually associated with noise. Our result is an extension of the Classical Shannon-Nyquist sampling theorem which states that for all bandlimited functions of a fixed bandwidth defined on Euclidean space one can find "not very dense" sampling sets which can be used to represent all relevant bandlimited functions. In some sense it allows to reduce the set of all points of Euclidean space to a countable set of points.